Notes on Occurrence of Young and Spawning of *Scomberomorus sierra* in the Eastern Pacific Ocean

W. L. Klawe[1]

ABSTRACT: Young of *Scomberomorus sierra* are briefly described and compared with young of other scombroids and some other related families. At sizes of 30–50 mm of total length young *S. sierra* can be distinguished from *S. concolor* on the basis of gill raker counts.

From this study, based on the collection of larvae and juveniles of *S. sierra,* it is evident that this species spawns near the coast over most of its distributional limits. Spawning off Mexico takes place in July through September and in lower latitudes from perhaps December through April.

RESUMEN: Los juveniles de *Scomberomorus sierra* se describen brevemente y se comparan con los juveniles de otros escombroides y con algunas otras familias afines. Cuando alcanzan la longitud total de 30 a 50 mm los juveniles de *S. sierra* pueden ser distiguidos de los de *S. concolor* en base al recuento de las branquispinas.

Es evidente, según este estudio basado en la recolección de larvas y juveniles de *S. sierra,* que estas especies desovan cerca a la costa en la mayor parte de sus límites de distribución. El desove frente a México toma lugar de julio a septiembre, y en las latitudes más bajas probablemente de diciembre a abril.

The genus *Scomberomorus* is represented in the eastern Pacific Ocean by two species, *S. sierra* and *S. concolor,* the sierra and the Monterey Spanish mackerel, respectively. The Spanish name most commonly applied to both species is "sierra." The distribution of *S. sierra* extends from California south to Peru and around the Galapagos Islands (Hildebrand, 1948; Roedel, 1953; Berdegué, 1956; and Collette et al., 1963). *S. concolor* ranges from California to perhaps as far south as the Gulf of Panama; in the last century it was fished commercially in the waters off California, but at present is considered to be rare there. The center of distribution of *S. concolor* appears to be the Gulf of California (Fitch and Flechsing, 1949). The uncertainty concerning the distribution of *S. concolor* is due to its superficial resemblance to *S. sierra.* The number of gill rakers on the first gill arch is the main character which distinguishes the two species from each other; counts for adults of the two species are:

species	upper arch	lower arch
S. sierra	2–4	10–12
S. concolor	5–9	15–20

Little is known of the spawning and early life history of the two species, especially of *S. concolor;* the only published information pertains or appears to pertain to *S. sierra.* According to Walford (1937), "sierra" in Mexican waters spawn probably in late spring or summer. Eckles (1949) indicates that in the more southern waters, particularly off Costa Rica, the time of spawning is most likely January and February. Clemens (1956) substantiated Eckles' conclusion by collecting juveniles of *S. sierra* in the Gulf of Panama in early February. The closely related Atlantic species, *S. maculatus,* spawns over a period of 6–10 weeks. The time of spawning is later in the northern parts of the Atlantic coast of the United States than in the southern parts (Earll, 1882).

While collecting young stages of tunas by means of dip-netting under a night light from commercial fishing vessels and research ships in waters of the eastern Pacific Ocean, staff mem-

[1] Inter-American Tropical Tuna Commission, La Jolla, California. Manuscript received June 9, 1965.

TABLE 1

RECORDS OF CAPTURE OF LARVAL AND JUVENILE *Scomberomorus sierra* FROM THE EASTERN PACIFIC REGION

DATE	GENERAL LOCALITY	LATITUDE	LONGITUDE	SIZE IN MM[1]	NO.	REFERENCE OR COLLECTOR
Jan. 29, 1912	Naos I., Gulf of Panama			107	1	Meek and Hildebrand (1923)[2]
July 26, 1913	Chame Pt., Gulf of Panama			12–67	20	Meek and Hildebrand (1923)[2]
Feb. 11, 1937	Ft. Amador, Gulf of Panama			92	1	Komp[2]
Feb. 26, 1937	Venado Beach, Gulf of Panama			59	1	Komp[2]
March 24, 1939	Potrero Grande Bay, Costa Rica			26.5–71	8	Eckles (1949)
April 16, 1941	Chilca Bay, Peru			109–139	7	Hildebrand (1946)[2]
Sept. 17, 1946	Acapulco, Guerrero, Mexico			"postlarvae and several juveniles"		Hubbs[3]
Feb. 1947	Gulf of Nicoya, Costa Rica			50.5	1	Eckles (1949)
Sept. 24 and 25, 1948	Ballenas Bay, Baja Calif., Mexico			21–23.25	3	Eckles (1949)
Aug. 28, 1951	Turtle Bay, Baja Calif., Mexico	27°39.7′N	114°52.3′W	16	1	J. Radovich[4]
Sept. 13, 1952	Off Boca de Sto. Domingo, Baja Calif., Mexico	25°34′N	112°19′W	4.5 and 9.5	2	?[5]
March 8, 1953	Cocos Pt., Isla del Rey, Gulf of Panama			30	2	L. R. Rivas[6]
March 27, 1954	Gulf of Papagayo, Costa Rica	10°31′N	86°12′W	11.5	1	Clemens[4]
April 18, 1954	Off Nicaragua	11°48′N	87°09′W	23	1	Clemens[4]
April 19, 1954	Off Nicaragua	11°42.5′N	87°09′W	17	1	Clemens[4]
Jan. 27, 1955	Charco Azul Bay, Gulf of Panama	8°15′N	82°47′W	13–67	16	Clemens[4]
Feb. 4, 1955	Gulf of Panama	8°31′N	78°56′W	13–24	12	Clemens[4]
Feb. 5, 1955	Gulf of Panama	8°06′N	79°06′W	12–58	14	Clemens (1956)[4]

Jan. 10, 1956	Gulf of Panama			36	1	A. Landa[7, 8]
Jan. 14, 1956	Off Punta Foca, Peru			9.5–22	97	G. W. Bane and G. C. Broadhead[7]
July 9, 1956	Uncle Sam Bank, Off Baja Calif., Mexico	25°34.5′N	113°45.5′W	8.4	1	?[5]
July 10, 1956	Ballenas Bay, Baja Calif., Mexico	26°39′N	113°11′W	53.5–72.5	8	J. J. Seapin[4]
July 27, 1956	Sta. Maria Bay, Baja Calif., Mexico	24°45.5′N	112°14.6′W	24–35	5	T. Jow[4]
July 28, 1956	Magdalena Bay, Baja Calif., Mexico	24°39′N	112°08′W	26–38.5	5	T. Jow[4]
July 31, 1956	Magdalena Bay, Baja Calif., Mexico	24°32.8′N	112°03.7′W	40	1	C. H. Turner[4]
Aug. 1, 1956	Sta. Maria Bay, Baja Calif., Mexico	24°42.7′N	112°10.7′W	28–33	15	C. H. Turner[4]
Aug. 1, 1956	Off Sta. Maria Bay, Baja Calif., Mexico	24°46.1′N	112°15′W	36–42	18	C. H. Turner[4]
Aug. 12, 1956	Off Boca de Sto. Domingo, Baja Calif., Mexico	25°34.2′N	112°18.7′W	4.8	1	?[5]
Sept. 23, 1956	Petatlan Bay, Guerrero, Mexico			36	1	Klawe[7]
April 7, 1957	Acajutla, El Salvador			29	1	Klawe[7]
Dec. 28, 1957	Farfan Beach, Gulf of Panama			39 + 106	2	P. W. Johnson[7]

[1] Direct distance from tip of snout to tip of the shortest median caudal ray.
[2] In the collection of the U. S. National Museum, Washington, D.C.
[3] Fieldbook data of C. L. Hubbs, Scripps Institution of Oceanography, La Jolla, California.
[4] In the collection of the California State Fisheries Laboratory, San Pedro, California.
[5] In the collection of the South Pacific Fishery Investigation of the U. S. Fish and Wildlife Service, La Jolla, California.
[6] In the collection of the University of Miami, Florida.
[7] In the collection of the Inter-American Tropical Tuna Commission, La Jolla, California.
[8] From a stomach of *Euthynnus lineatus*.

bers of the California State Fisheries Laboratory and the Inter-American Tropical Tuna Commission have captured a variety of fish, including juveniles of *Scomberomorus*. As will be shown later, there is reason to believe that most likely all of these *Scomberomorus* specimens are young of *S. sierra*. The information pertaining to these collections is summarized in Table 1. Also included in the table are data kindly provided by other scientists, as well as published data. The geographical distribution of the catches, all of which originated from coastal waters, is shown in Figure 1.

An 11-mm *S. sierra* collected off Punta Foca, Peru in January 1956 is illustrated in Figure 2. The head, with its long snout, and the large jaws beset with numerous teeth are characteristic of young *sierra* at this stage and serve to distinguish it readily from other scombroids of similar size. Juvenile *Scomberomorus* are also

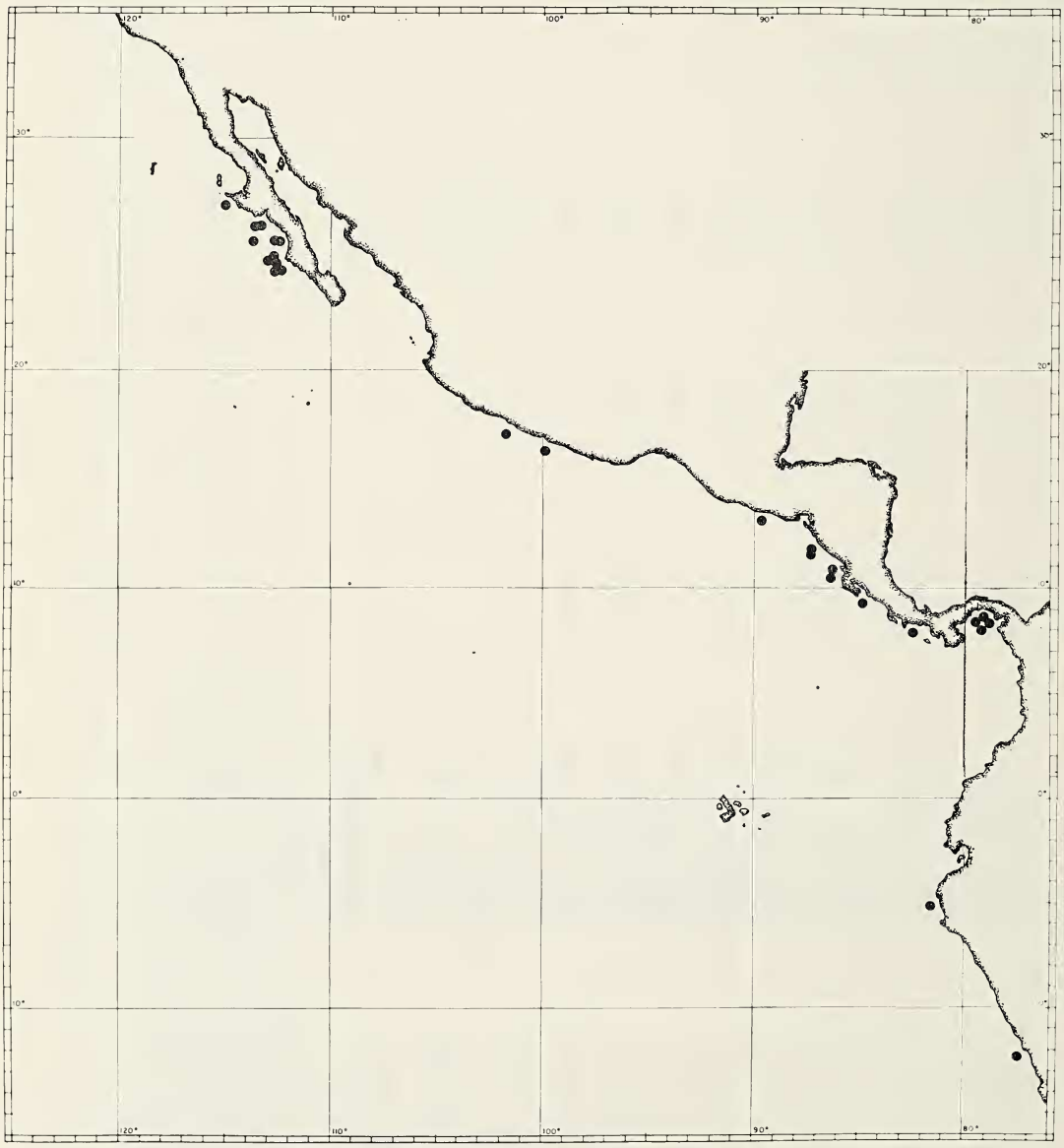

FIG. 1. Localities of capture of juvenile *Scomberomorus sierra* in the eastern Pacific Ocean.

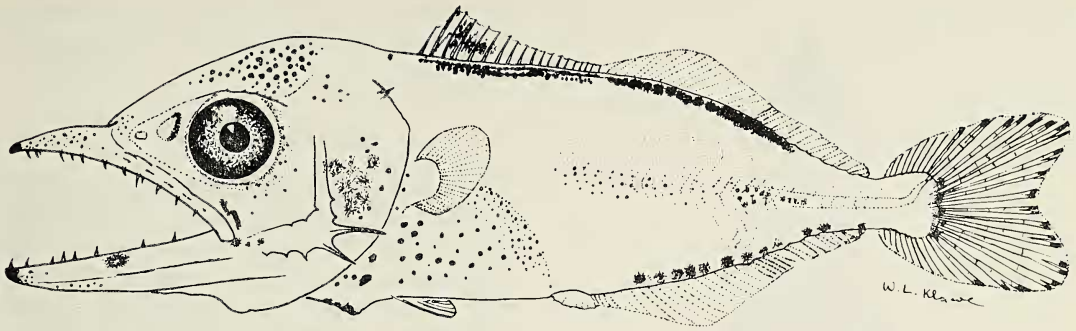

FIG. 2. *Scomberomorus sierra,* 11 mm-long specimen, caught off Punta Foca, Peru.

easily separable from other tuna and tuna-like fishes on the basis of shape, meristic counts, and pigmentation patterns. Noteworthy is the arrangement of head spines illustrated in Figure 3, which represents the dorsal aspect of the head of a specimen 12 mm long from the collection off Punta Foca, Peru. The serrated supraorbital crest shown in that figure is, in the family Scombridae, not restricted only to young of *S. sierra.* Such a crest has been reported for young *Sarda chiliensis* (Pinkas, 1961). Perhaps it may be characteristic of some other members of the family Scombridae phylogenetically closer to the families of Istiophoridae and Xiphiidae, which are considered to be evolved from the scombrids. Young swordfish, marlins, and sailfish at a certain stage of their development are provided with a serrated supraorbital crest. Such a serrated crest is also present in young Gempylidae. *Scomberomorus* and *Acanthocybium* share with the gempylids a cartilaginous projection surmounting the mandibular symphysis (Strasburg, 1964). The appearance of the specimens of young *S. sierra* agrees with the detailed description given by Hildebrand and Cable (1938) for *S. maculatus* and that of Eckles (1949) for *S. sierra.*

Although the number of gill rakers on the first gill arch is useful in separating adults of the two species of *Scomberomorus* found in the eastern Pacific Ocean, young *Scomberomorus* do not have an entire complement of fully developed gill rakers. The full complement is present in individuals on young scombroids (*Thunnus, Euthynnus, Auxis,* and *Sarda*) of 40–60 mm in total length (Klawe and Shimada, 1959; Klawe, 1961). Counts were made on the material in this report to establish species identity and the size at which the full complement of gill rakers is attained. Counts of gill rakers made on juvenile scombroids are to a certain extent subjective because, in the smaller individuals, the gill rakers are represented merely as small protuberances along the arch. Because of this subjectivity it is necessary to be wary when comparing counts on young scombroids made by different investigators. From the counts of the total number of gill rakers (Fig. 4), we may assume that the fish in this collection belong to one species because the increase in the number of gill rakers with the increase in size appears to follow a curve which levels off at a size between about 30–50 mm. This leveling off occurs at a number of gill rakers characteristic for *S. sierra.*

It is likely that the Peruvian specimen (Fig. 2) is but a few days old, in view of the rapid growth of young *sierra* noted by Clemens (1956) in his experiments. The fact that still smaller (9.5 mm) specimens of *S. sierra* were also captured at the same time and in the same area suggests that the spawning of *S. sierra* takes place in this region in January. From the summary of the records of capture of juvenile *sierra* (Table 1), this species probably spawns near the coast over most of its distributional limits in the eastern Pacific Ocean. Spawning off Mexico takes place in July, August, and September, and in lower latitudes perhaps from December through April. The conclusions as to time of spawning should be considered as speculative; the question of the spawning time of *sierra* cannot be resolved until more complete data on the occurrence of eggs or young

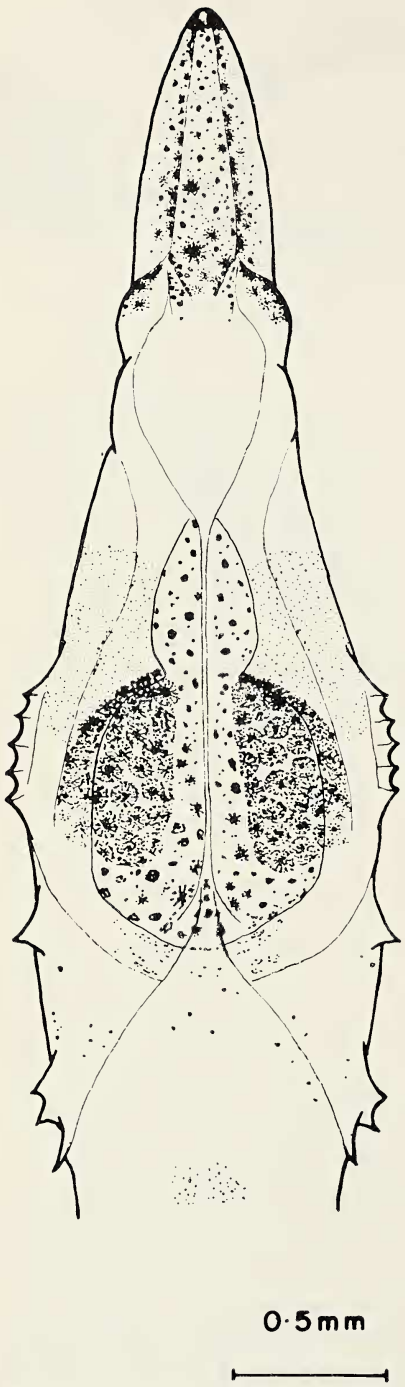

FIG. 3. *Scomberomorous sierra,* 12 mm long; dorsal view of the head. Specimen caught off Punta Foca, Peru.

stages or both come to hand, or until research on the seasonal development of the gonads is carried out.

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REFERENCES

BERDEGUÉ A., JULIO. 1956. Peces de importancia comercial en la costa nor-occidental de México. Comisión para el Fomento de la Piscicultura. 345 pp.

CLEMENS, HAROLD B. 1956. Rearing larval scombroid fishes in shipboard aquaria. Calif. Fish and Game 42(1):69–79.

COLLETTE, B. B., F. H. TALBOT, and R. H. ROSENBLATT. 1963. The first California record of sierra, *Scomberomorus sierra* Jordan and Starks. Calif. Fish and Game 49(1):53–54.

EARLL, R. EDWARD. 1882. The Spanish mackerel, *Cybium maculatum* (Mitchill) Agassiz; its natural history and artificial propagation, with an account of the origin and development of the fishery. Rept. U. S. Commissioner Fish and Fisheries, 1880 (1883):395–426.

ECKLES, HOWARD H. 1949. Observations on juvenile oceanic skipjack (*Katsuwonus pelamis*) from Hawaiian waters and sierra mackerel (*Scomberomorus sierra*) from the east-

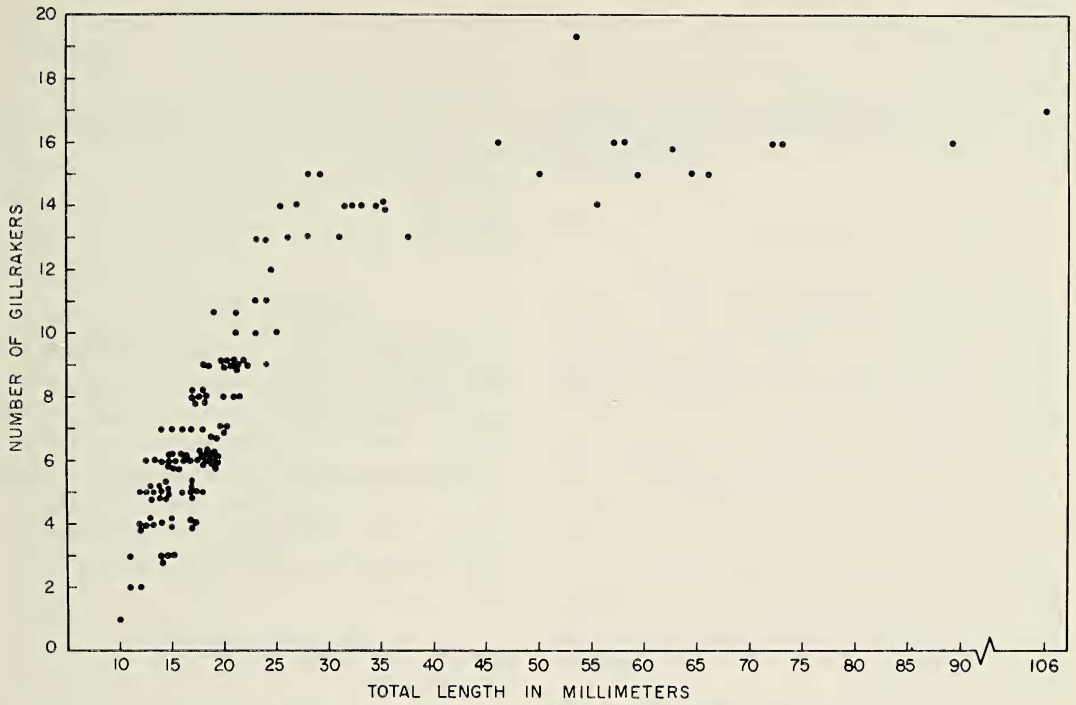

FIG. 4. Gill raker counts of young *Scomberomorus sierra* plotted against total length.

ern Pacific. U. S. Fish and Wildlife Serv. Fish Bull. 51(48):243–250.

FITCH, JOHN E., and ARTHUR O. FLECHSING. 1949. A brief account of the Monterey Spanish Mackerel (*Scomberomorus concolor*). Calif. Fish and Game 35(4):275–280.

HILDEBRAND, SAMUEL F. 1946. A Descriptive Catalog of the Shore Fishes of Peru. U. S. Natl. Mus. Bull. 189. 530 pp.

——— and LOUELLA E. CABLE. 1938. Further notes on the development and life history of some teleosts at Beaufort, N. C. U. S. Bureau Fish. Bull. 48(24):505–642.

KLAWE, W. L. 1961. Notes on larvae, juveniles, and spawning of bonito (*Sarda*) from the eastern Pacific Ocean. Pacific Sci. 15(4): 487–493.

——— and BELL M. SHIMADA. 1959. Young scombroid fishes from the Gulf of Mexico. Bull. Mar. Sci. Gulf and Carib. 9:100–115.

MEEK, S. E., and S. F. HILDEBRAND. 1923. The Marine Fishes of Panama. Publ. Field Mus. Nat. Hist., Zool. Series 15, part 1 (1923):i–xii + 330 pp.

PINKAS, LEO. 1961. Description of postlarval and juvenile bonito from eastern Pacific Ocean. Calif. Fish and Game 47(2):175–188.

ROEDEL, PHIL M. 1953. Common Ocean Fishes of the California Coast. Calif. Dept. Fish and Game, Fish Bull. 91, 184 pp.

STRASBURG, DONALD W. 1964. Postlarval scombroid fishes of the genera *Acanthocybium, Nealotus,* and *Diplospinus* from the Central Pacific Ocean. Pacific Sci. 18(2): 174–185.

WALFORD, L. A. 1937. Marine Game Fishes of the Pacific Coast from Alaska to the Equator. Contributions Santa Barbara Mus. Nat. Hist., Univ. California Press. 205 pp.